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INTERACTION BETWEEN THE STUDENT AND COLLEGE ENVIRONMENT.

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A THEORETICAL SCHEME WAS DISCUSSED FOR MATCHING STUDENTS TO COLLEGES THROUGH THE USE OF A DIRECTORY WHICH COULD CONTAIN PROFILES OF STUDENT CHARACTERISTICS AND OF COLLEGE ENVIRONMENTAL CHARACTERISTICS. EACH PROFILE WOULD CARRY A DESIGNATED INDEX NUMBER FACTORED FROM THE INPUT OF GIVEN CHARACTERISTIC VARIABLES. WHEN USED BY THE STUDENT AND HIS COUNSELOR, A CORRELATION OF THE INDEX NUMBER OF THE PROFILE MOST LIKE A PROFILE OF THE STUDENT AND THE INDEX NUMBER OF A PARTICULAR COLLEGE WOULD YIELD PREDICTIVE OUTPUT INFORMATION RELEVANT TO ACHIEVEMENT OF SUCH SPECIFIC GOALS, AS ACQUISITION OF A PARTICULAR DEGREE, STIMULATING ACADEMIC ATMOSPHERE, AND FINANCIAL AND GEOGRAPHIC LIMITATIONS. THE COLLEGE ADMISSIONS OFFICER COULD USE THE DIRECTORY TO ASSIST IN THE SELECTION OF THOSE STUDENTS WHO MIGHT BEST AID IN THE MAINTENANCE OR THE ACQUISITION OF PRECONCEIVED STANDARDS. THE HIGH SCHOOL COUNSELOR AND THE ADMISSIONS OFFICER WOULD NOT USE THE DIRECTORY TO MAKE FINALIZED, AUTOMATED PERSONNEL DECISIONS, BUT AS A TOOL TO BE USED ALONG WITH OTHER INFORMATION. THIS PAPER WAS PRESENTED TO THE AMERICAN PERSONNEL AND GUIDANCE ASSOCIATION CONVENTION (DALLAS, MARCH, 1967) AS PART OF THE SYMPOSIUM, "IMPLICATIONS OF A PROGRAM OF RESEARCH ON STUDENT DEVELOPMENT IN HIGHER EDUCATION." (AO)

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Interaction Between the Student and the College Environment*

American Council on Education
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The previous speakers on this symposium have described several aspects of the ACE program of longitudinal research on higher education. Special opportunities are provided in this program for studying the characteristics of students and the institutions they attend, using the wide range of data obtained from a nationwide representative sample. Beyond this lies the further opportunity to study interactions between the students and their college environments.

The term"interaction" has several meanings in common usage. A sociologist might say we were having an interaction this morning, an exchange of views, a dialogue. The idea is that each participant is doing something to or with each other participant. Similarly, it would be meaningful to speak of the interaction between a student and his college: what the student contributes to being there and what happens to him by his being there. But there is another, special, and very useful sense of the term, interaction, that I would like to discuss this morning, in the context of predicting the student's educational development in college. We assume that he and his college are already interacting in the first sense. His characteristics as a student, as a person, have been reviewed by his high school guidance counselor and by several admissions officers, and somehow, the interactions between him and some admissions officers have resulted in his now being a freshman at college X. I shall not be concerned with how he became college-bound in the first place, nor why he is in college X rather than college Y. Many of you can probably tell me a good deal more about these matters than I can tell you. One goal of our studies is to provide objective, factual information that is relevant and useful to the general problem of matching the college-bound student with an institution of higher education.

Relevant and useful for what? I assume that certain output criteria or operational manifestations of educational objectives are to be maximized. In terms of the Council's research program, we are concerned with prediction of the kinds of output criteria such as retention in higher education, plans for graduate study, career choice, academic performance, acquired skills, values and interests. Such predictions are made from potentials for growth and learning that the student brings with him into the higher educational institution, and from those environmental aspects of the higher educational institution that are capable of affecting his subsequent development. To see more clearly what is involved, and the meaning of a student-environment interaction in the context of such a prediction, let us look at Figure 1 of the handout and consider a very oversimplified example. Note in this figure that prediction of the output comes from three kinds of sources: the main effect of the student input, the main effect of college environment, and the interaction effect from a match between a student and an institution.

Suppose we have as an input variable some measure of the student's ability and past achievement, e.g., college entrance examination scores. Suppose we also have a measure of a particular college's academic level, e.g., the average ability of the students attending that institution. We wish to predict the probability that a student with a certain college entrance level attending an institution with a certain academic level will complete a baccalaureate degree. By noting what happens to many students attending many different institutions, we may calculate a weighted sum of the freshman ability score and of the academic level of the institution that will maximize prediction of graduation. Such a prediction equation is the first one shown in Figure 2. The first term takes into account one of the main effects considered so far, i.e., that a bright student is more likely to graduate. Students in institutions with higher academic level may or may not be more likely to graduate. In either case this main effect of the college is taken into account by the second term of the equation. Of course, the brighter students are more likely to

attend the institutions with higher academic level. This fact is reflected in the correlation between the two predictors and is taken into account when the weights are computed for the prediction equation.

Beyond this, however, there are additional effects which we have not yet considered. And here is where we get into the idea of the effect of an interaction between the student and his college environment in the context of prediction. We are concerned with the effects of particular matches between the student and his environment. In our example, a bright student matched with an institution with high academic level may find this a stimulating environment. Note also, he contributes to that environment for the other students attending that institution. Conversely, a dull student may find such an institution discouraging, and a bright student may become disgusted if matched with an institution that fails to provide an intellectually stimulating environment. The weights in the prediction equation we discussed earlier may not be the same for these different student-college matches. It would be conceivable, but perhaps impractical to provide different prediction equations for each kind of student-environment combination for every possible combination of predictors and outcomes. Fortunately, we can handle this problem by introducing one more term into our prediction equation for these matches, or interactions between the student input variable and the college environment variable, as shown in the second equation. This term is the product of the two scores and will receive its appropriate weight in maximizing the prediction of the outcome, baccalaureate completion.

The research program is concerned not only with developing equations that maximize predction of practical outcomes, but also in developing a better understanding of the higher education system. One way to do this is to compare the efficiency of prediction when various terms of the prediction equations are alternately included or excluded. Suppose we found that omitting

the interaction term resulted in little or no loss of prediction. It would mean that the various kinds of interactions I mentioned earlier were not relevant to predicting this particular outcome, and we could use the simpler equation #1 for prediction. Suppose, however, it did make a substantial difference. Not only would we want to keep the term in prediction, but we would then be interested in the different types of matches that made the difference.

This could be investigated either by sorting our data into the different interaction types (H-H, H-L, L-H) or by generating and investigating a more elaborate prediction equation involving the interactions between levels on each predictor.

When I said earlier that we had an oversimplified example, I meant we were dealing with one student characteristic such as his college entrance composite, one institutional characteristic such as the academic level of student body, and one outcome (baccalaureate completion). Neither the student, the guidance counselor, nor the admissions officer would want to put all the eggs in one basket. The student has a profile of many characteristics; he is one of many students with very similar patterns of abilities, interests, aspirations, and financial resources. The institution has many characteristics that might affect student development; it is one of several institutions with a similar pattern of student input characteristics, administrative policies, physical and academic facilities. This implies prediction equations of a more complex nature, such as equation number 3 in Figure 2. There are many different outcomes to be considered differently, according to the needs of the user. E.g., the student aspiring to a career that does not require graduate education will not need to give as much weight to prediction of that criterion as one who aspires to scientific research or certain other professional careers. How, then, are we to select, digest, and present the vast information involving many input, environmental, and outcome variables? Some of our studies are aimed to meet this need. We can study redundancy of information so that the number of variables is

reduced to those which make independent contributions to predicting outcomes. We can ascertain which student-environment interactions are important in prediction and which are not. We can ascertain which profiles or combinations of student and institution characteristics yield the same prediction and can therefore be treated the same way in personnel decisions.

How, then, would such information properly evaluated, digested, and presented, be useful? To answer this, I would like to tell you about a dream. Like most dreams, there is no way to be sure that the contents will come true in the form they were dreamt. Unlike most dreams, which are alleged to represent riotous symbolism from unconscious processes, this one has both coherence and practical possibilities.

I dreamt that after a few years of carefully done and well-supported research, we produced a document about the size of the Dallas telephone directory. This directory would be divided into two sections. The first, or main section is designed to maximize the convenience of a high school guidance counselor during his discussions with a student. In the second section, the yellow pages are designed to maximize the convenience of a college admissions officer. At the very back are useful indexes to student and college environment profiles. Let us look at the main section first. There is a page, or group of pages for each type of student. In the first scene of our dream the counselor has a student for whom he has obtained information from school records, test scores, and prior counseling interviews.

A typical page of the main section of the directory is shown schematically in figure 3 for a white, male, protestant with college board scores of 600. This student has aspirations to become a medical doctor, but is not sure he has the financial resources and persistence to carry this through. He realizes he should consider being a medical technician. Even if he is sure he can complete graduate study, he is not sure he wants to be in clinical practice and might consider being a research biologist. Such possible outcomes are listed on the left, designating rows of

the table. The counseling session involves discussion of particular institutions that seem to be geographically and financially feasible for this student, but which provide different environments and imply different outcome probabilities for a student with this set of characteristics. These institutions may be looked up in the index to ascertain their college environment profiles designation. For example college A may be a large public university with liberal administrative policies, broad curricular offerings, and a student body with high intellectual level, but given to considerable Joe College carousing. The index says this profile is number 5, so we look in column 5 to find predicted outcome information if this student goes to College A. College B may be a small, protestant, liberal arts college with some science curricula, severe administrative policies against drinking, moderately high intellectual level of the student body, and an unusually excellent and well used library. The college environment profile index says this is profile number 37, so we look in column 37 for predicted output information, if this student were to go to this college.

You might wonder why we do not have a column for every college. One reason is the same as why we do not have a row for every student. Our directory would become too big. So one phase of our research involves the taxonomy of colleges in terms of their environmental characteristics. But there is another, more important practical reason. Because of uncertainties about the acceptance of his application to a particular college, many students hedge their bets and submit multiple applications. By knowing what other collegeshave a similar profile and implied set of predicted outcomes for him, some rationality may be introduced into this shotgun approach to college application. This information can be combined with other considerations, e.g. financial and geographical, which might reasonably effect feasibility of applying for admission to a particular institution.

Going down the columns 5 and 37 for the profiles of colleges A and B, we find the probability of this kind of student completing a baccalaureate is .4 at college A and .7 at college B. However, the counselor does not tell the student that college B, or any of the colleges in profile 37 is better. He notes that college A graduates are more likely to enter graduate study, .3 versus .2, and that a greater proportion of students like him at college A still want to be physicians on graduation. If the student were absolutely sure that he was bound for medical school, and the choice were really his, college A would seem to be a better bet, provided he were willing to work hard. But remember our student's career goals are not absolutely crystalized, and that he recognizes the need for some flexibility in his planning. We would want to look at the other career choice rows, for research biologist and medical technician. The counselor might then tell the student, "College A is better for one of your goals, college B for another (if this is the case). Have you considered college C (profile number 23), which is not quite as appropriate for any of your goals, but provides favorable chances on several?" In other words our dream directory would not make finalized, automated personnel decisions, nor should it. It provides objective information in readily available form to aid the counselor in his discussions with the student.

How does such a table relate to the prediction equations involving main effects and interaction? At the right side of the table we show the outcomes predicted from the student input main effect regardless of what college this kind of student attends. For a given outcome, the values in the rows will vary considerably where the college environment main effect and the student-by-college environment interactions add to the predictability of the outcome. This is more likely to occur with students and institutions having jagged profiles,

emphasizing special characteristics of either. One further point needs to be made about the values tabulated. Where the outcomes are categorical, the tabled values are predicted probabilities of membership in a category, as we have been assuming. If the outcome is a continuous variable, the tabled values may either be predicted levels on the outcome variable, or probabilities that the predicted value lies above a certain level.

Now let us move on to the next scene in the dream. An admissions officer at a private sectarian college has more applicants than dormitory space. This institution is less concerned in its educational objectives about providing input to graduate schools than it is in maintaining a certain atmosphere and developing certain religious and moral values in its students. Or it may be an institution that provides more readily by its faculty and physical facilities for educating some career groups than others. In either case the admissions officer is forced to be selective. What does he do? He "lets the Yellow Pages do the walking."

Figure 4 shows the schematic layout for a typical yellow page of the directory. Each page in this section refers to a college environment profile. Our admissions officer chooses the page that describes his own institution. Each column now represents some outcome that this institution may consider representative of its educational capabilities and goals. The admissions officer goes down these columns to find predicted outcomes in favorable ranges and looks over to the left to see what student profiles to prefer. Having read the profile numbers, he can look them up in the student profile index to obtain a description of the type of students having such profiles.

Like the guidance counselor, the admissions officer must be careful <u>not</u> to use the index to finalize a personnel decision. The directory information is partial input to be weighed into whatever selection process he is using. For him, too, or for his institution, excessive concern about achieving one admissions goal may be inconsistent with achieving another goal. He would be well advised

to look at more than one outcome column of the yellow page relevant for his institution.

This kind of table relates to the prediction equations involving main effects and interactions in a manner similar to that discussed before for the tables in the main section. There is one difference. Here we show a row at the bottom of the table which presents predicted outcomes on the various criteria for this type of institution no matter what student input profile is considered. This last row shows the outcomes predicted only from the main effect of that particular college environment profile. For a given outcome, values in the columns will vary considerably where the student profile main effects and the student-by-college environment interactions add to the predictability of that outcome.

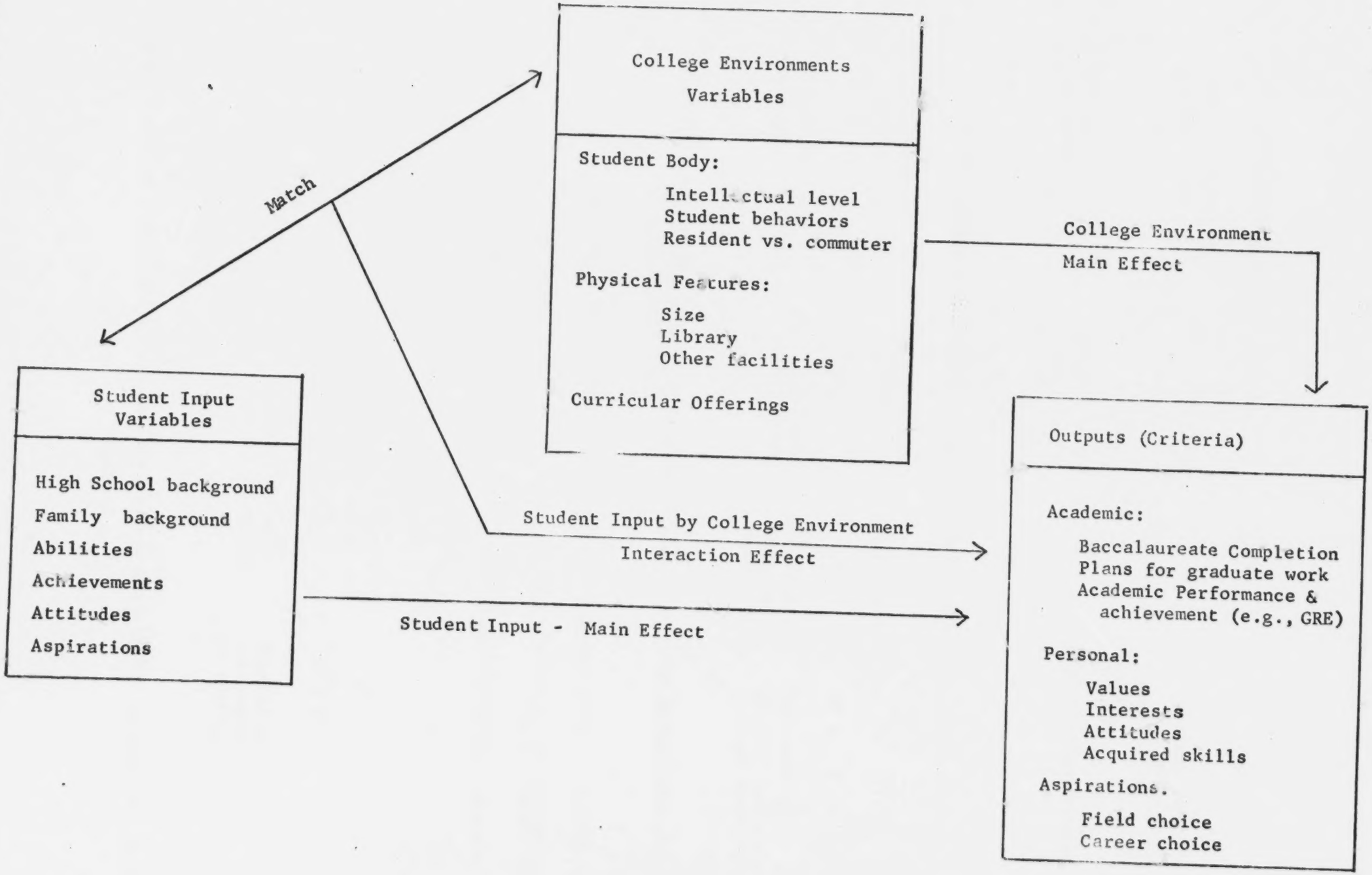
Further consideration of the potential of such a directory suggests its utility in other kinds of problems. For example, our guidance counselor may be faced with a very different kind of problem. Suppose the student already has an institution in mind (the father is an illustrious alumnus and junior is going to alma mater no matter what), but the counseling session is focused on choice of major field or later career. In this situation either section of the directory can be consulted to ascertain those field and career choices most likely for this combination of student and college profile.

Similarly, the admissions officer may have a fixed policy of admission in terms of student profile ranges, more or less determined by certain geographic and economic factors, i.e., the pipeline is given. The institutional capabilities, and educational goals may be under considerable discussion among members of the administration and faculty. Should a certain department be added or expanded? Should certain changes be made in administrative policy more in line with the types of students normally entering this institution? If certain changes are

made, which goals will be more nearly reached and which less so? Directory information would provide quite useful, objective information, relevant to such decisions.

The guidance counselor working with undergraduates, as well as the high school counselor, would find such a directory useful. For example, he may be counseling with students contemplating transfer into, or out of that particular institution. In another situation, the student may be considering possible changes in either major field or choice of career, in which case the predicted implications of such a change would be relevant.

Whether or not such dream content becomes manifest as a part of higher education, at least in such convenient and formal terms as indicated here, this kind of information is obviously useful and a natural product of the ACE program of longitudinal research in higher education.



Elaboration of ACE Longitudinal Research Design

Figure 1

I. Simple Main Effects Model

Baccalaureate Completion		Ability		Intellectualism
$\hat{Y}_I$	=	W_1X_{Si}	+	W_2X_{CE}
(Predicted Outcome)		(Student Input Main Effect)		(College Environment Main Effect)

II. Simple Model with Student Input-by-Environment Interaction Term

Baccalaureate Completion		Ability		Intellectualism		
$\hat{Y}_{II}$	=	W_3X_{SI}	+	W_4X_{CE}	+	$W_5X_{SI}X_{CE}$
(Predicted Outcome)		(Student Input Main Effect)		(College Environment Main Effect)		(interaction between Student Input and College Environment)

III. Expanded Model with Student Input Profiles, College Environment Profiles, and Interaction Terms.

$$\hat{Y} = (W_1X_1 + W_2Y_2 + W_3X_3 + \ldots) + (W_aX_a + W_bX_b + W_cX_c + \ldots\ldots)$$

ability; achievement; aspiration — Student Input Profile

intellectualism; size; policy — College Environment Profile

$$+ (W_{1a}X_1X_a + W_{1b}X_1X_b + \ldots\ldots\ldots + W_{2b}X_2X_b)$$

Student ability by intellectualism of student body

Student abiltiy by size of college

Student High School achievement by size of college

Some Types of Prediction Equations Showing Main Effects and Interaction Terms

Figure 2

Subsection for Student Profile No. 117

Student Characteristics:

White Protestant Male
College Board Scores - 600

Output Criteria	College Environment Profile Number					Student Profile Main Effect
	01	02. . . .	05	23. . .	37 . .	
Educational Aspirations						
Baccalaureate Completion	.	.	.4	.6	.7	.5
Entry into Graduate School	.	.	.3	.3	.2	.2
Doctorate Attainment	.	.	.2	.2	.1	.1
Career Choices						
Physician	.	.	.1	.2	.1	.1
Biologist	.	.	.2	.2	.1	.2
Medical Technician	.	.	.1	.1	.1	.1
Engineer	.	.	.1	.2	.3	.2
Artist	.	.	.3	0	.3	.2
Lawyer	.	.	.2	.1	.1	.2
Other	.	.	.	.	.	.

Schematic Example of a Page from Main Section

Figure 3

Subsection for College Environment Profile No. 23

College Environment Characteristics: 4 year private, Protestant College with Intellectualism 520 .....

Student Profile Number	Output Criteria										
	Educational Aspirations			Career Choices							
	Graduate Completion	Entry into Grad. School	Ph.D. Attainm't	Physician	Biologist	Med. Tech.	Engineer	Artist	Lawyer	Other
001 002 117	.6	.3	.2	.2	.2	.1	.2	0	.1	.....
200										
College Environment Main Effect	.7	.3	.2	.2	.1	.2	.2	.1	.1	

Schematic Example of a Page from the "Yellow Pages"

Figure 4